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UPPER MESOZOIC MICROFLORAS IN WELL CORES FROM WOODSIDE AND HEDLEY, VICTORIA

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Abstract

Three microfloras of Albian, ?Albian and possibly Neocomian-Aptian ages are recorded from Woodside Wells Nos. 1, 2 and 3 and Hedley Well No. 1. These sediments are correlated with other Victorian and South Australian deposits which contain comparable microfloras.

Introduction

During the recent search for oil in Victoria, five exploratory wells were sunk by Woodside (Lakes Entrance) Oil Company No Liability in South Gippsland. Four of these wells were drilled near Woodside, 11 m. E. of Yarram and one near Hedley, 10 m. E. of Yarram.

Woodside Well No. 4 entered, but did not pass through, the Tertiary formation. The other four wells, Woodside Wells Nos. 1, 2 and 3 and Hedley Well No. 1, were sunk through the Tertiary formation, and entered, but did not penetrate through, the underlying Mesozoic formation (Boutakoff 1956, 1957/58). The deepest well, Woodside Well No. 2, passed through approximately 5,200 ft. of Mesozoic sediments before drilling was abandoned at 8,862 ft.

The Mesozoic sediments intersected by these four wells are lacustrine and consist of interbedded mudstones, shales, claystones and arkoses with minor amounts of bituminous coal seams (unpublished information, Woodside Oil Co's Bore log). No well defined marker beds have been recorded and consequently no stratigraphical subdivision has yet been made. It was decided to carry out a palynological investigation of the Mesozoic sediments in these Woodside and Hedley wells, in the hope of establishing a stratigraphical succession by means of the microfloras present.

Two distinct microfloras of a Lower Cretaceous age, one Albian and the other probably Neocomian-Aptian, and a microflora which is intermediate between these two, have been described from deposits in SE. Australia (Cookson and Dettmann 1958). The Albian microflora was then recorded from sediments in the Woodside Well No. 2 between 4,251 ft. and 6,402 ft., and in the Hedley Well No. 1 at 2,132 ft. The Neocomian-Aptian microflora was not observed in any of the Woodside and Hedley well samples examined at that time, although it was recorded from other South Gippsland Mesozoic deposits, including outcrop and bore samples from the Wonthaggi State Coal Mine Area, Cape Paterson, Berry Creek, Whitelaw, Korumburra and Tyers River. The only recorded occurrence of the intermediate microflora in South Gippsland is from sediments in several of the Alberton West Bores (Cookson and Dettman 1959).

The present investigation of the Upper Mesozoic deposits from the Woodside and Hedley wells shows that the presence of Albian, Neocomian-Aptian and intermediate microfloras provides a useful means of stratigraphically subdividing these sediments. Woodside Well No. 2 provided the most complete vertical succession of

sediments, the examination of which shows that the three microfloras occur at different levels in the well. On the basis of these three microfloras, correlations are made between the Woodside Well No. 2 sediments and those in the Woodside Wells Nos. 1 and 3 and Hedley Well No. 1, and the Woodside succession is also correlated with other Lower Cretaceous deposits in Victoria and South Australia.

Microfloral Assemblages

Although only a relatively small proportion of the microspore and pollen types present in these deposits has been named and described, the following lists are adequate for correlation and comparative purposes.

A. Woodside Well No. 2.

The Tertiary-Mesozoic boundary in this well was struck at 3,500 ft. and the well was bottomed within the Mesozoic formation at 8,862 ft. Nine core samples have been examined. One of these, at 4,858 ft., contained no spores or pollen grains, while the others yielded the following microfloral assemblages:

1. Dense mudstones containing plant remains at 4,114-27 ft. and 4,251-6 ft.

The spores and pollen grains occurring at these levels, although not numerous, are varied and well preserved. Some of the microspores occurring in the deposit at 4,251-6 ft. have been recorded previously (Cookson and Dettmann 1958), but for completeness these are included in the following list:

(a) Megaspores—*Pyrobolospora hexapartita* (Dijkstra) (4,114-27 ft. only).

(b) Microspores—*Apiculatisporis asymmetricus* Cookson and Dettmann, *Ceratosporites equalis* Cookson and Dettmann, *Cicatricosisporites australiensis* (Cookson), *Cingulatisporites euskirchensoides* Delcourt and Sprumont, *Cingulatisporites paradoxus* Cookson and Dettmann, *Cingulatisporites simplex* Cookson and Dettmann, *Cirratriradites spinulosus* Cookson and Dettmann, *Divisisporites euskirchenensis Thomson* (4,251-6 ft. only), *Dictyotosporites complex* Cookson and Dettmann, *Foveosporites canalis* Balme, *Ischyosporites scaberis* Cookson and Dettmann, *Leptolepidites verrucatus* Couper, *Lycopodiumsporites austroclavatidites* (Cookson), *Lycospora mollis* Cookson and Dettmann, *Osmundacidites comaumensis* (Cookson), *Perotrilites striatus* Cookson and Dettmann, *Pilosisporites notensis* Cookson and Dettmann, *Reticulatisporites pudens* Balme.

(c) Pollen—*Microcachryidites antarcticus* (Cookson), *Classopollis* sp. (This genus requires further investigation before specific designation is made.)

2. Sandy, massive dark grey shale at 5,989 ft.

The microspores and pollen types present in the deposit are poorly preserved and infrequent and include:

(a) Microspores—*Apiculatisporis asymmetricus, Cicatricosisporites australiensis, Ischyosporites scaberis, Leptolepidites verrucatus, Lycopodiumsporites austroclavatidites, Lycospora mollis, Osmundacidites comaumensis, Perotrilites striatus, Pilosisporites notensis.*

(b) Pollen — *Microcachryidites antarcticus, Podosporites micropterus* (Cookson and Pike), *Zonalapollenites dampieri* Balme.

3. Dark grey shale at 6,402 ft.

The microflora present in this deposit, which is both rich and varied, contains a number of types which have not been observed in the higher sediments of this well. The following list includes a number of microspore types which have been previously recorded from this deposit (Cookson and Dettmann 1958):

(a) Microspores — *Apiculatisporis asymmetricus, Ceratosporites equalis, Cicatricosisporites australiensis, Cingulatisporites euskirchensoides, Cirratriradites spinulosus, Dictyotosporites complex, Dictyotosporites speciosus* Cookson and Dettmann, *Granulatisporites dailyi* Cookson and Dettmann, *Ischyosporites scaberis, Kuylisporites lunaris* Cookson and Dettmann, *Leptolepidites verrucatus, Lycopodiumsporites austroclavatidites, Lycopodiumsporites circolumenus* Cookson and Dettmann, *Neoraistrickia truncatus, Osmundacidites comaumensis, Perotrilites striatus, Pilosisporites notensis.*

(b) Pollen—*Classopollis* sp., *Microcachryidites antarcticus, Pityosporites grandis* (Cookson), *Zonalapollenites dampieri.*

4. Pale grey shales at 6,485 ft. and 6,892 ft.

The well preserved, but sparse, microspores and pollen grains present in these deposits include:

(a) Microspores—*Apiculatisporis asymmetricus, Apiculatisporis wonthaggiensis* Cookson and Dettmann, *Ceratosporites equalis, Cicatricosisporites australiensis, Cicatricosisporites cooksoni* Balme (6,485 ft. only), *Dictyotosporites complex, Dictyotosporites speciosus, Granulatisporis dailyi, Ischyosporites scaberis, Leptolepidites verrucatus, Lycopodiumsporites austroclavatidites, Lycopodiumsporites circolumenus* (6,485 ft. only), *Lycospora mollis, Neoraistrickia truncatus, Osmundacidites comaumensis, Perotrilites striatus, Pilosisporites notensis* (6,892 ft. only), *Cyclosporites hughesi* (Cookson and Dettmann 1959b) (6,892 ft. only).

(b) Pollen—*Classopollis* sp., *Microcachryidites antarcticus, Podosporites micropterus, Pityosporites grandis, Zonalapollenites dampieri.*

5. Medium and fine grained grey siltstone at 7,785 ft.

The microflora at this level is not rich in types and the preservation of those present is poor. The following forms have been recognized:

(a) Microspores—*Cicatricosisporites australiensis, Dictyotosporites speciosus, Granulatisporites dailyi, Ischyosporites scaberis, Lycopodiumsporites austroclavatidites, Osmundacidites comaumensis, Cyclosporites hughesi.*

(b) Pollen—*Microcachryidites antarcticus, Zonalapollenites dampieri.*

6. Medium and fine grained, dark grey siltstone at 8,862 ft.

This sample is highly carbonaceous and contains cuticle and woody tissue. The spores and pollen grains, which in general are not well preserved, include: .

(a) Microspores — *Apiculatisporis wonthaggiensis, Ceratosporites equalis, Cicatricosisporites australiensis, Dictyotosporites complex, Dictyotosporites speciosus, Granulatisporites dailyi, Ischyosporites scaberis, Kuylisporites lunaris, Leptolepidites verrucatus, Lycopodiumsporites austroclavatidites, Lycospora mollis, Osmundacidites comaumensis, Pilosisporites notensis, Cyclosporites hughesi.*

(b) Pollen—*Classopollis* sp., *Podosporites micropterus, Zonalapollenites dampieri.*

B. Woodside Well No. 1.

This well penetrated through approximately 2,000 ft. of Mesozoic sediments, the Tertiary-Mesozoic boundary was struck at 3,900 ft. and the well was bottomed at 6,008 ft. One of the samples examined (at 5,950-5 ft.) contained a rich and varied spore and pollen assemblage, but neither of the other two (at 4,098-108 ft. and at 5,292 ft.) yielded spores nor pollen grains.

Fine grained carbonaceous mudstone at 5,950-5 ft.

The spore and pollen types present in this deposit include:

(a) Megaspores — *Minerisporites marginatus* (Dijkstra), *Pyrobolospora reticulata* Cookson and Dettmann.

(b) Microspores — *Apiculatisporis asymmetricus, Ceratisporites equalis, Cicatricosisporites australiensis, Cingulatisporites euskirchensoides, Cingulatisporites paradoxus, Cingulatisporites simplex, Cirratriradites spinulosus, Dictyotosporites complex, Foveosporites canalis* Balme, *Lycopodiumsporites austroclavatidites, Lycospora mollis, Neoraistrickia truncatus, Osmundacidites comaumensis, Perotrilites striatus, Pilosisporites notensis, Reticulatisporites pudens.*

(c) Pollen — *Classopollis* sp., *Microcachryidites antarcticus, Podosporites micropterus, Pityosporites grandis.*

C. Woodside Well No 3.

The Mesozoic sequence was entered at 3,815 ft., and approximately 2,000 ft. of this sequence was penetrated by the well. Two samples were examined, and both yielded a rich microfloral assemblage.

1. Massive dark grey shales and sandstones at 5,368 ft.

The following spore and pollen types have been observed:

(a) Megaspores—*Pyrobolospora reticulata.*

(b) Microspores — *Apiculatisporis asymmetricus, Ceratosporites equalis, Cicatricosisporites australiensis, Cingulatisporites euskirchensoides, Cingulatisporites paradoxus, Cingulatisporites simplex, Ischyosporites scaberis, Lycopodiumsporites austroclavatidites, Lycospora mollis, Neoraistrickia truncatus, Osmundacidites comaumensis, Perotrilites striatus, Pilosisporites notensis, Reticulatisporites pudens.*

(c) Pollen—*Classopollis* sp., *Microcachryidites antarcticus, Pityosporites grandis, Podosporites micropterus.*

(d) Incertae Sedis—*Shizosporis rugulatus* Cookson and Dettmann, *Shizosporis spriggi* Cookson and Dettmann.

2. Dark grey shales and sandstones at 5,711-24 ft.

The carbonaceous content of this deposit consists of cuticle, woody tissue and well preserved spores and pollen grains which include:

(a) Microspores — *Apiculatisporis asymmetricus, Ceratosporites equalis, Cicatricosisporites australiensis, Dictyotosporites speciosus, Granulatisporites dailyi, Ischyosporites punctatus* Cookson and Dettmann, *Ischyosporites scaberis, Lycopodiumsporites austroclavatidites, Neoraistrickia truncatus, Osmundacidites comaumensis, Perotrilites striatus, Pilosisporites notensis.*

(b) Pollen—*Classopollis* sp., *Microcachryidites antarcticus, Pityosporites grandis, Zonalapollenites dampieri.*

D. Hedley Well No. 1.

Four core samples have been examined. Two of these, at 1,459 ft. and 4,009 ft., are devoid of spores and pollen grains. The other two, which consist of dark grey carbonaceous mudstones and siltstones at 2,099-106 ft. and 2,132-7 ft., contain cuticle, woody tissue and relatively few spores and pollen grains. These include:

(a) Microspores—*Apiculatisporis asymmetricus, Apiculatisporites wonthaggiensis, Cicatricosisporites australiensis, Dictyotosporites speciosus* (2,132-7 ft. only), *Granulatisporites dailyi, Ischyosporites scaberis, Leptolepidites verrucatus,*

Lycopodiumsporites austroclavatidites, Lycospora mollis, Osmundacidites comaumensis, Perotrilites striatus, Pilosisporites noteusis.

(c) Pollen—*Classopollis* sp., *Microcachryidites antarcticus, Pityosporites grandis, Podosporites micropterus.*

Stratigraphical Conclusions

This study indicates that there are two distinct microfloras, and one of a type intermediate between them, in the Mesozoic deposits intersected by the Woodside and Hedley wells. Each of the two distinct microfloras contains certain spore species which have a limited stratigraphical range; some of these spore species have been recorded previously from deposits of Albian age, and others from deposits which are probably Neocomian-Aptian (Cookson and Dettmann 1958). The intermediate type of microflora resembles that recorded from deposits regarded as ?Albian (Cookson and Dettmann 1958, 1959a). These facts enable a tentative age to be established for the deposits which were examined from the Woodside and Hedley wells.

The sediments at 4,114-27 ft., 4,251 ft. and 5,989 ft. in Woodside Well No. 2, 5,950-5 ft. in Woodside Well No. 1 and 5,368 ft. in Woodside Well No. 3 contain short-range spore species such as *Perotrilites striatus, Cingulatisporites euskirchensoides, Cingulatisporites paradoxus, Cingulatisporites simplex, Apiculatisporis asymmetricus* and *Pyrobolospora reticulata.* These species are found in the marine Lower Cretaceous (Albian) beds at 581 ft. and 810 ft. in the Cootabarlow Bore No. 2, South Australia and in the Onepah Well, New South Wales (Cookson and Dettmann 1958). Both the Onepah Well deposits and these levels of the Cootabarlow Bore are believed to be of Albian age. This estimate of the age is based, in the case of the Cootabarlow beds, on the contained foraminifera (N. H. Ludbrook, South Australian Department of Mines Palaeontological Report—14/56, 1956 unpublished) and microplankton (Cookson and Eisenack 1958), and in the case of the Onepah Well sediments on the gasteropods and ammonites (Fletcher in Deflandre and Cookson 1955) and microplankton (Cookson and Eisenack 1958). This evidence indicates a similar Albian age for these Woodside and Hedley sediments.

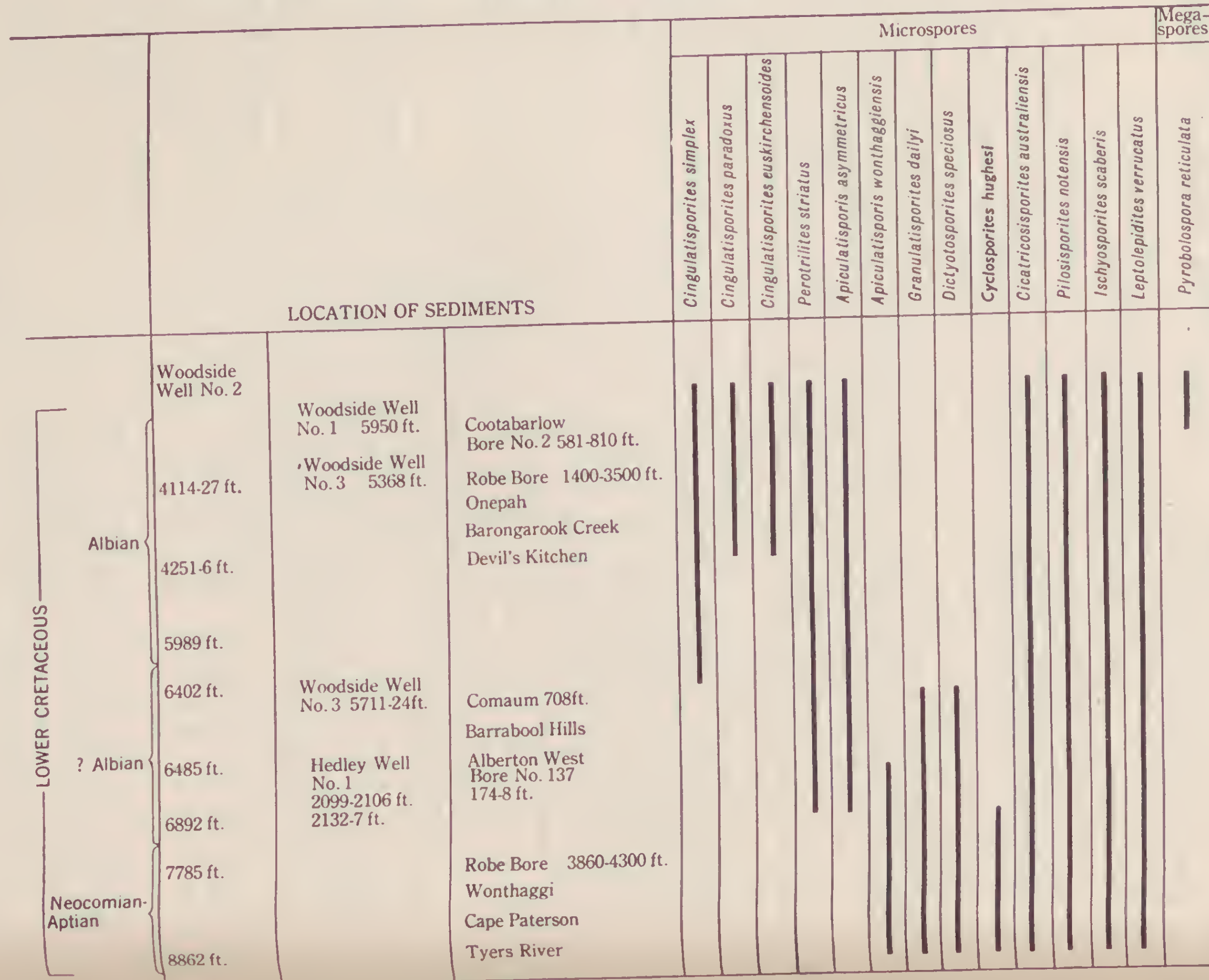
A comparable age has been suggested by Cookson and Dettmann (1958) for other lacustrine deposits in Victoria and South Australia which contain a similar microflora (Table 1). These deposits are from Barongarook Creek near Colac, Devil's Kitchen 3 m. SE. of mouth of Gellibrand River, at 532 ft. and 582 ft. in Dergholm Bore No. 1 and between 1,400-3,500 ft. in the Robe Bore.

The sediments at 7,785 ft. and 8,862 ft. in Woodside Well No. 2, in containing the short-range species *Cyclosporites hughesi, Apiculatisporis wonthaggiensis, Granulatisporites dailyi and Dictyotosporites speciosus,* are comparable to the deposits from the Wonthaggi State Coal Mine Area, Tyers River and Cape Paterson in Victoria and at 3,860 ft. and 4,300 ft. in the Robe Bore, South Australia, which also contain this microflora. The age of these latter deposits is almost certainly pre-Albian (probably Neocomian-Aptian or possibly uppermost Jurassic (Cookson and Dettmann 1958), and it is probable that the sediments at 7,785 ft. and 8,862 ft. in Woodside Well No. 2 are of an equivalent age.

A microflora intermediate between the typical Albian and pre-Albian microfloras is present in the deposits at 6,402 ft., 6,485 ft. and 6,892 ft. in Woodside Well No. 2, at 5,711-24 ft. in Woodside Well No. 3 and at 2,099-106 ft. and 2,132-7 ft. in Hedley Well No. 1. These deposits contain the short-range spore species *Perotrilites striatus* and *Apiculatisporis asymmetricus* typical of the Albian microflora, together

TABLE 1

The range of some of the spore species occurring in the Woodside and Hedley Well sediments and approximate correlations between these sediments and other Victorian and South Australian deposits.



with the short-range spore species *Granulatisporites dailyi, Dictyotosporites speciosus* and *Apiculatisporis wonthaggiensis* of the pre-Albian microflora.

A similar admixture of Albian and pre-Albian spore species has been recorded from the following sediments: (a) at 674 ft. and 708 ft. in the Comaum Bore, South Australia; (b) Barrabool Hills, Victoria; (c) Alberton West, Victoria (1) at 174 and 178 ft. in Bore No. 137; (2) at 265 ft. in Bore No. 159; (3) at 215 and 237 ft. in Bore No. 135. The age of these sediments has been suggested as ?Albian by Cookson and Dettmann (1958, 1959a), and the Woodside and Hedley sediments in containing this microflora are probably equivalent in age (?Albian).

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